

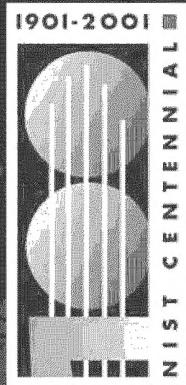
# STEADY-STATE MEASUREMENT OF THERMAL CONDUCTIVITY OF CERAMICS AND CERAMIC COATINGS

Andrew J. Slifka

NIST, Materials Reliability Division  
Boulder, Colorado 80305 USA

and

D.D. Hass and H.N.G. Wadley  
Department of Materials Science  
University of Virginia  
Charlottesville, Virginia 22903 USA



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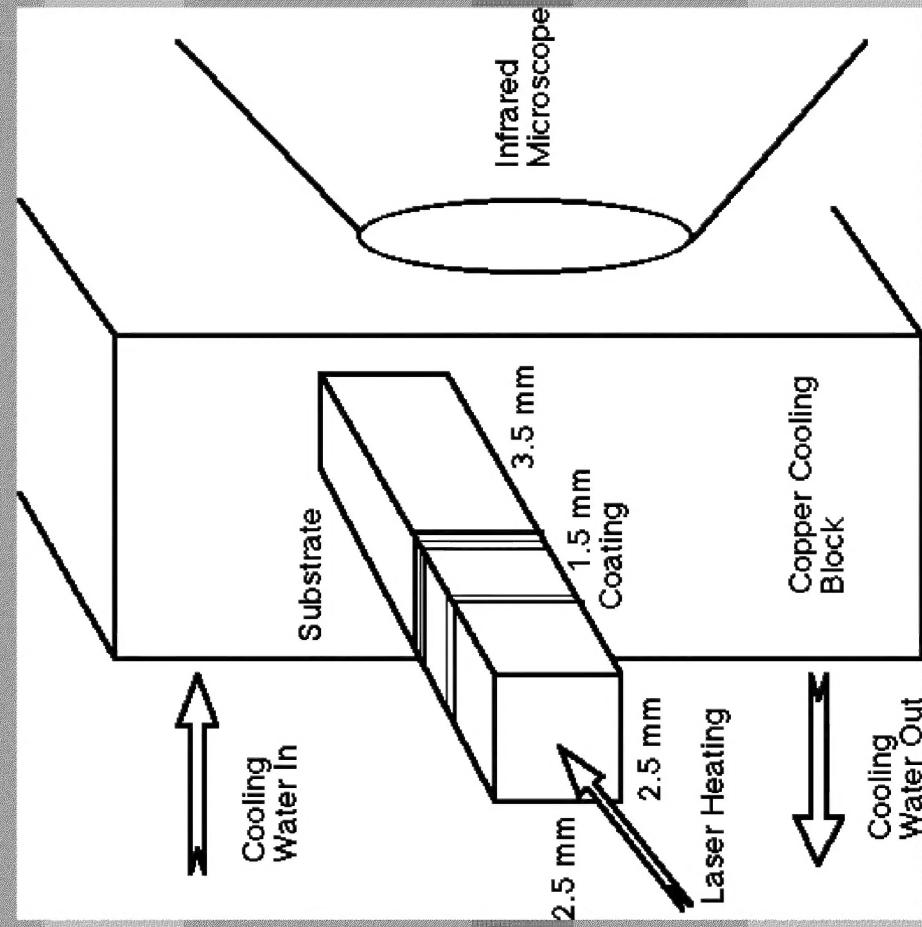
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# Discussion Points

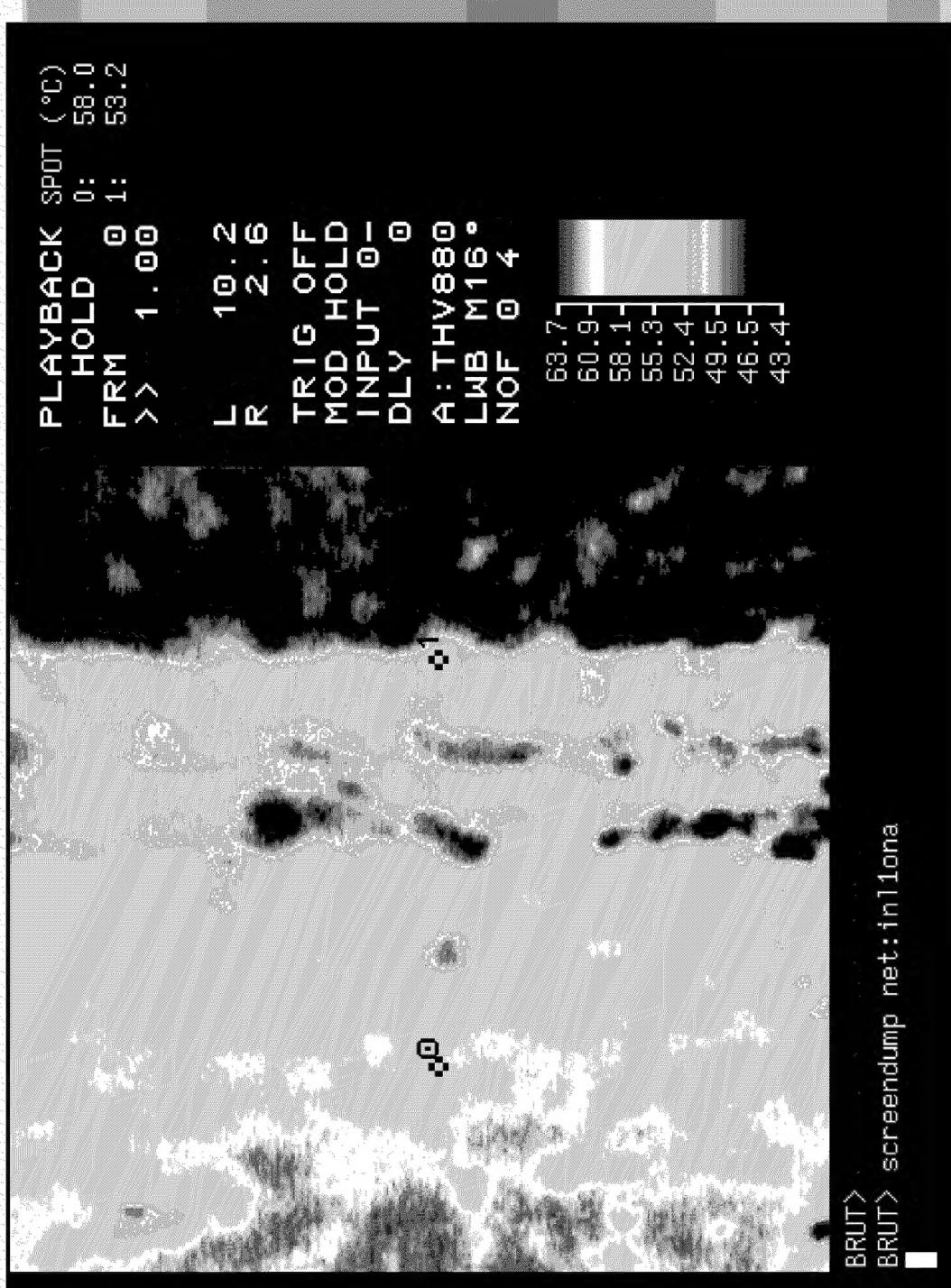
- Steady-State Measurement Method
- Validation
- EB-PVD → EB-DVD
- Future Direction (SPM)

# Measurement using Infrared Microscopy

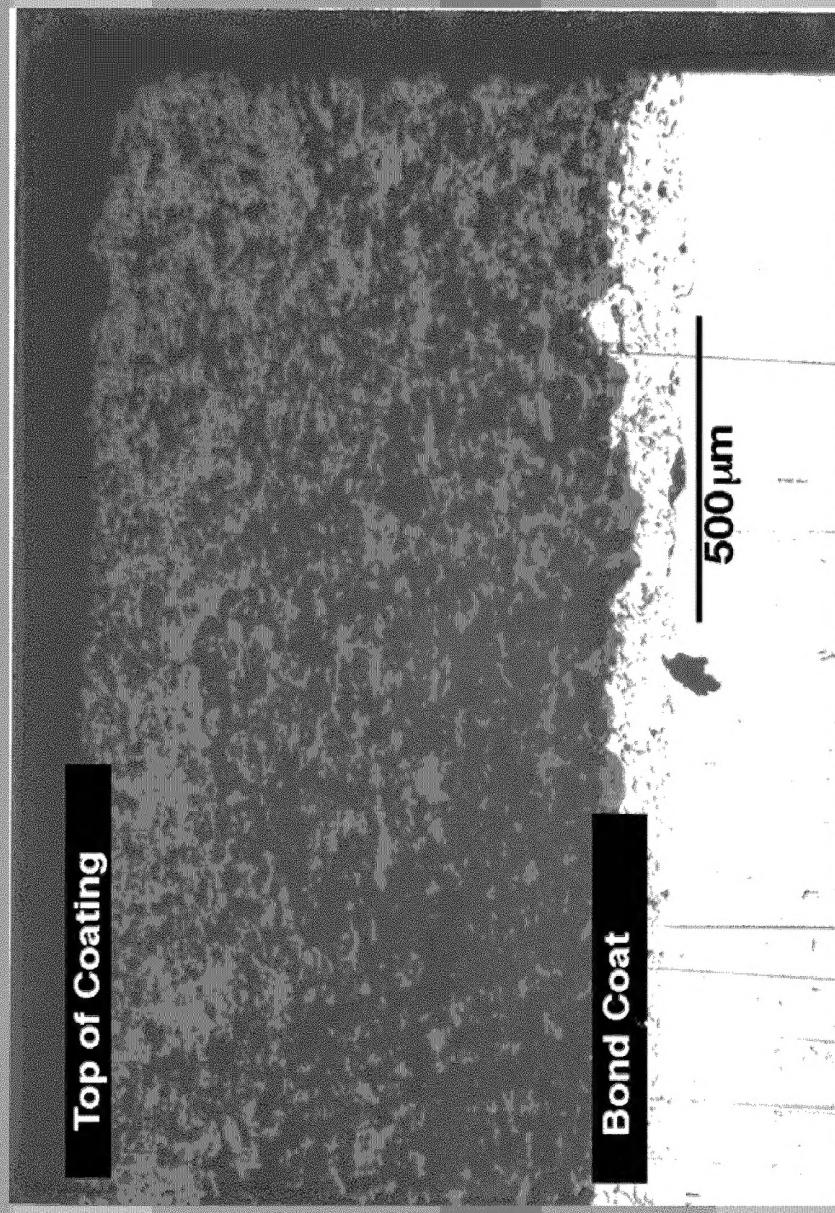
- 1.6 x 1.6 mm field-of-view
- 8 to 12  $\mu\text{m}$  detection
- 10  $\mu\text{m}$  spatial resolution
- Room temperature to 250  $^{\circ}\text{C}$
- steady-state
- laser or Joule heating



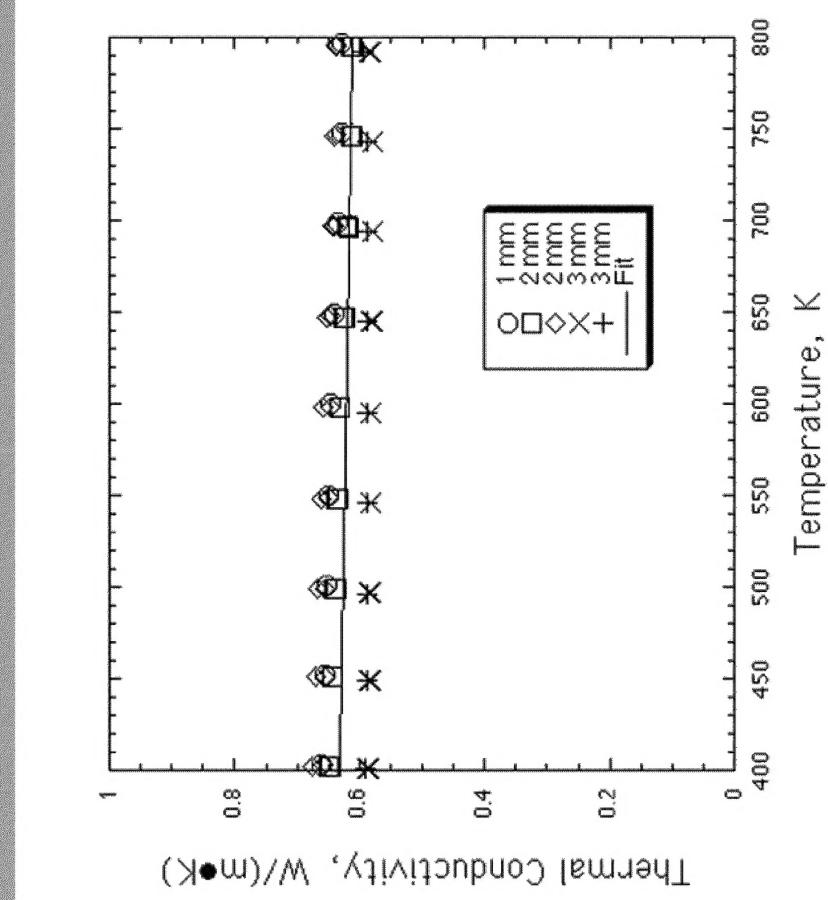
# Infrared Micrograph of an Alumina-Nickel, 4-layer Functionally Graded Coating on a Nickel Substrate



# Plasma-Sprayed 1.0 mm thick 8% Yttria-Stabilized Zirconia Coating with 0.1 mm thick NiCrAlY Bond Coat on 410 Stainless Steel

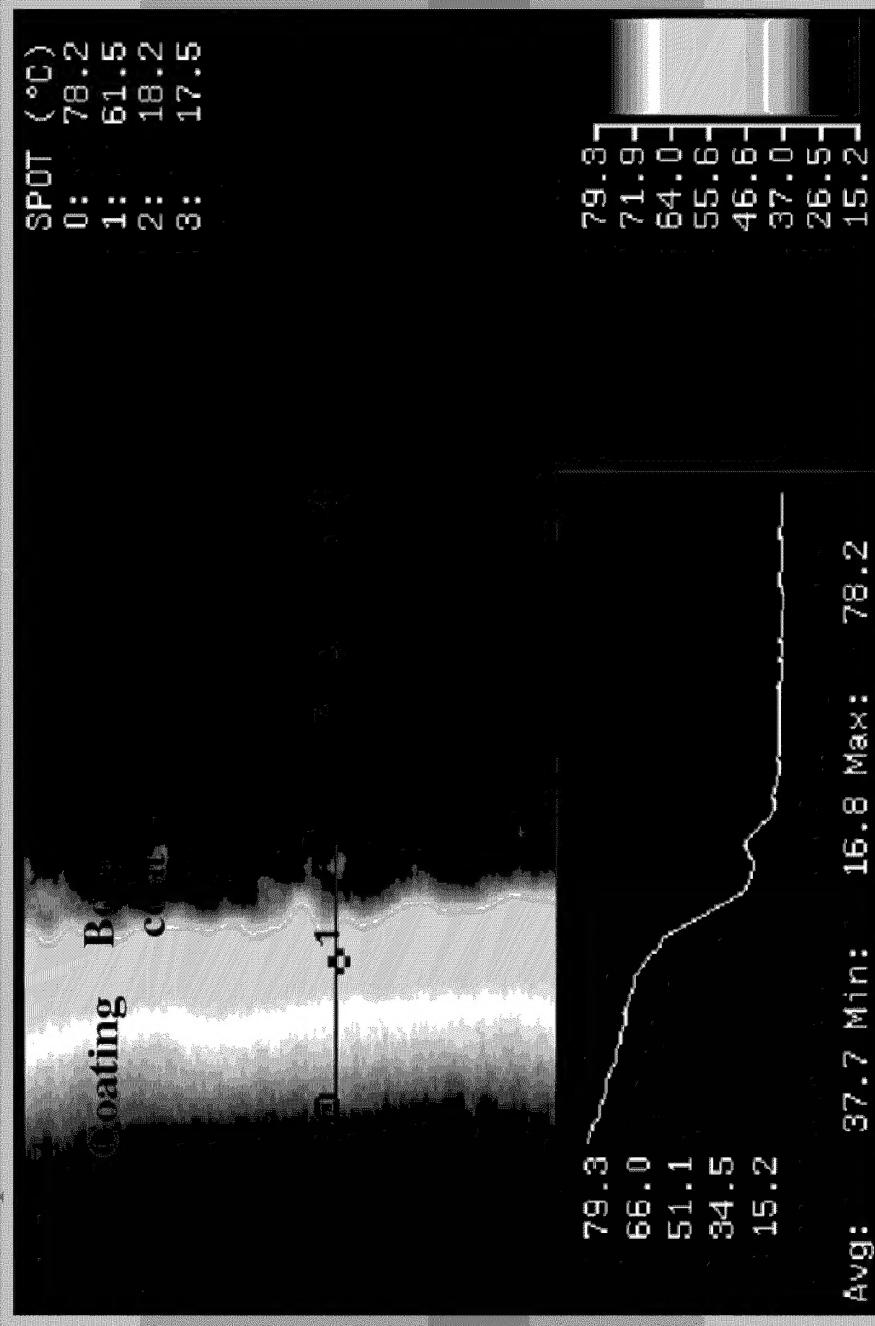


# Results for an 8% Yttria-Stabilized-Zirconia Coating on 410 Stainless Steel

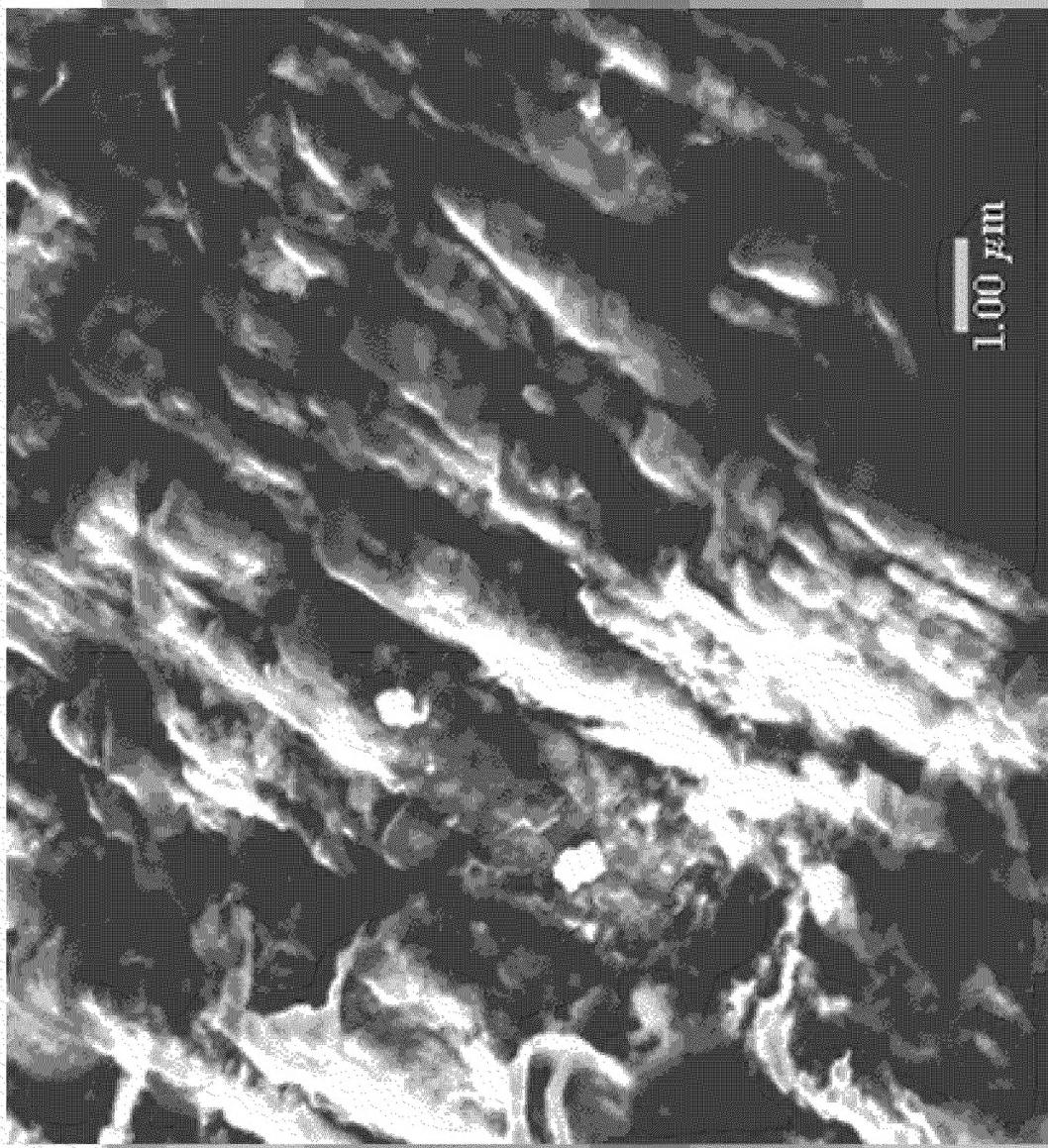


# Infrared Microscope Image of a Plasma Sprayed 8% Yttria-Stabilized Zirconia Coating, 1.0 mm thick, on a 0.1 mm thick NiCrAlY Bond Coat on 410 SS

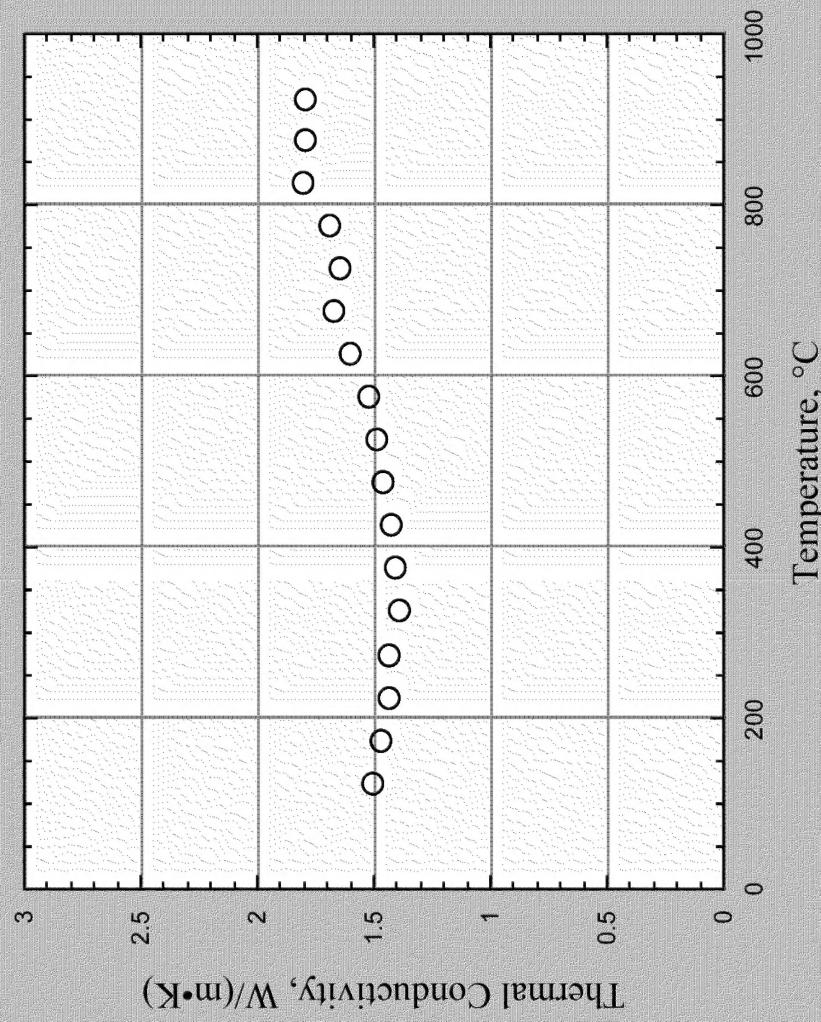
- Specific Interfacial Thermal Resistance  $4.1 \text{ E-}4 \text{ m}^2 \cdot \text{K/W}$



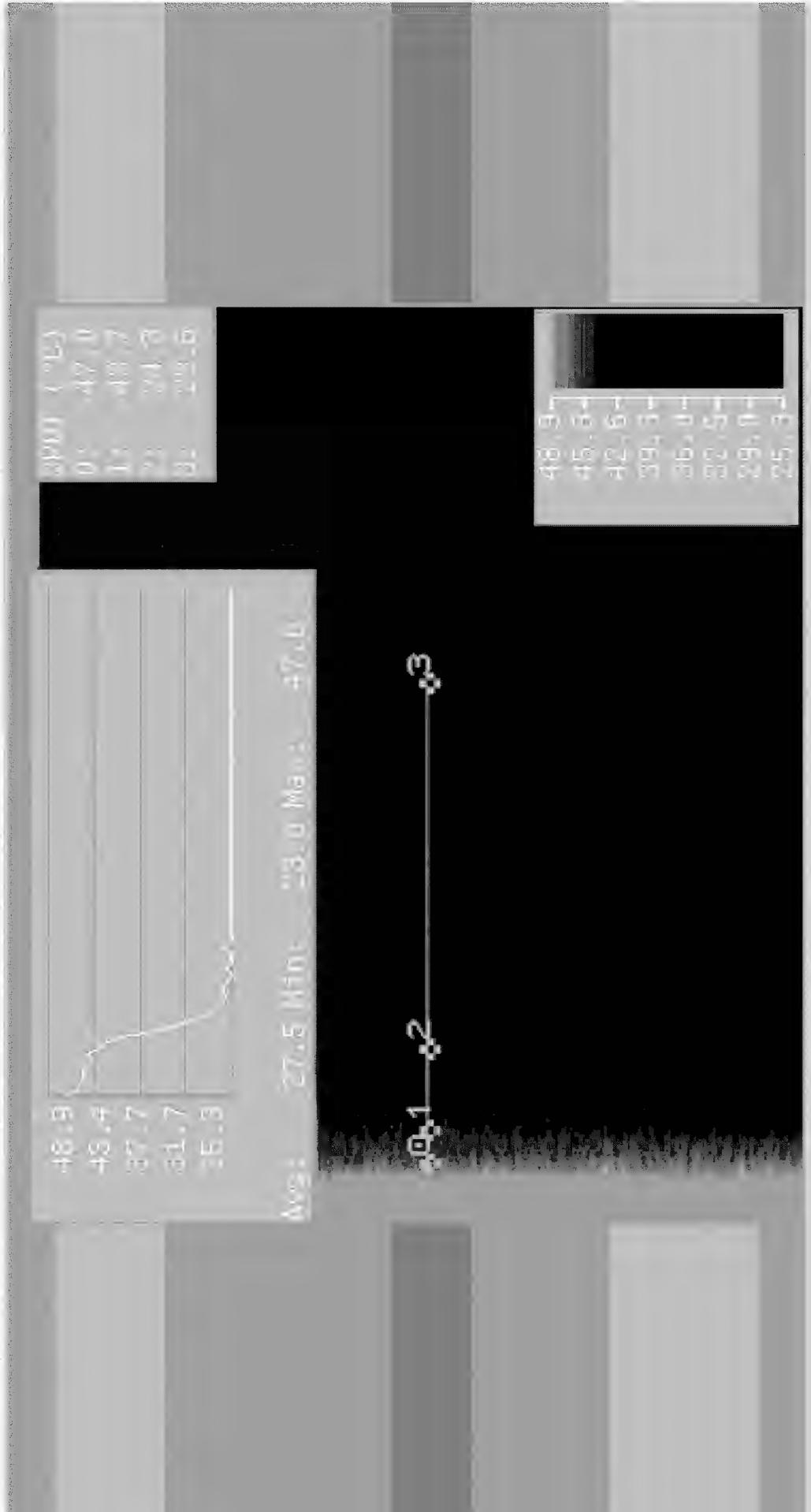
# Microstructure of a 7% YSZ EB-PVD Coating



# GHP Measurement of an EBPVD Coating from an Industrial Collaborator

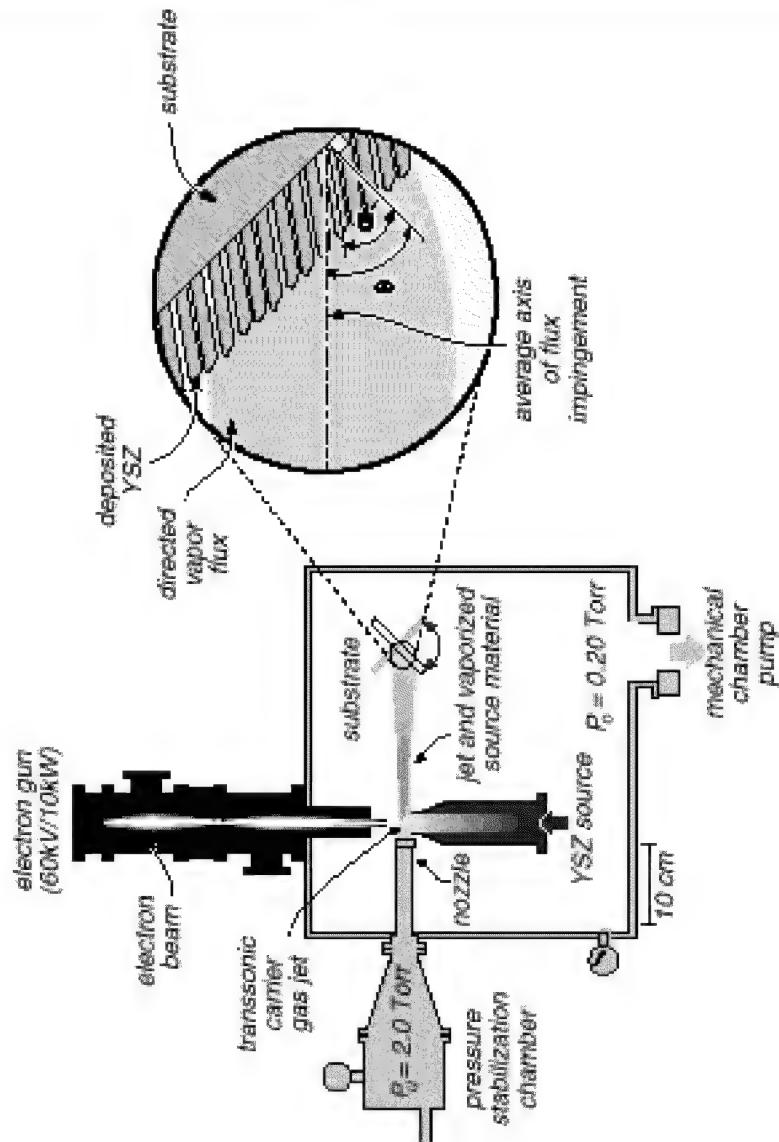


# Infrared Image of an EBPVD Coating

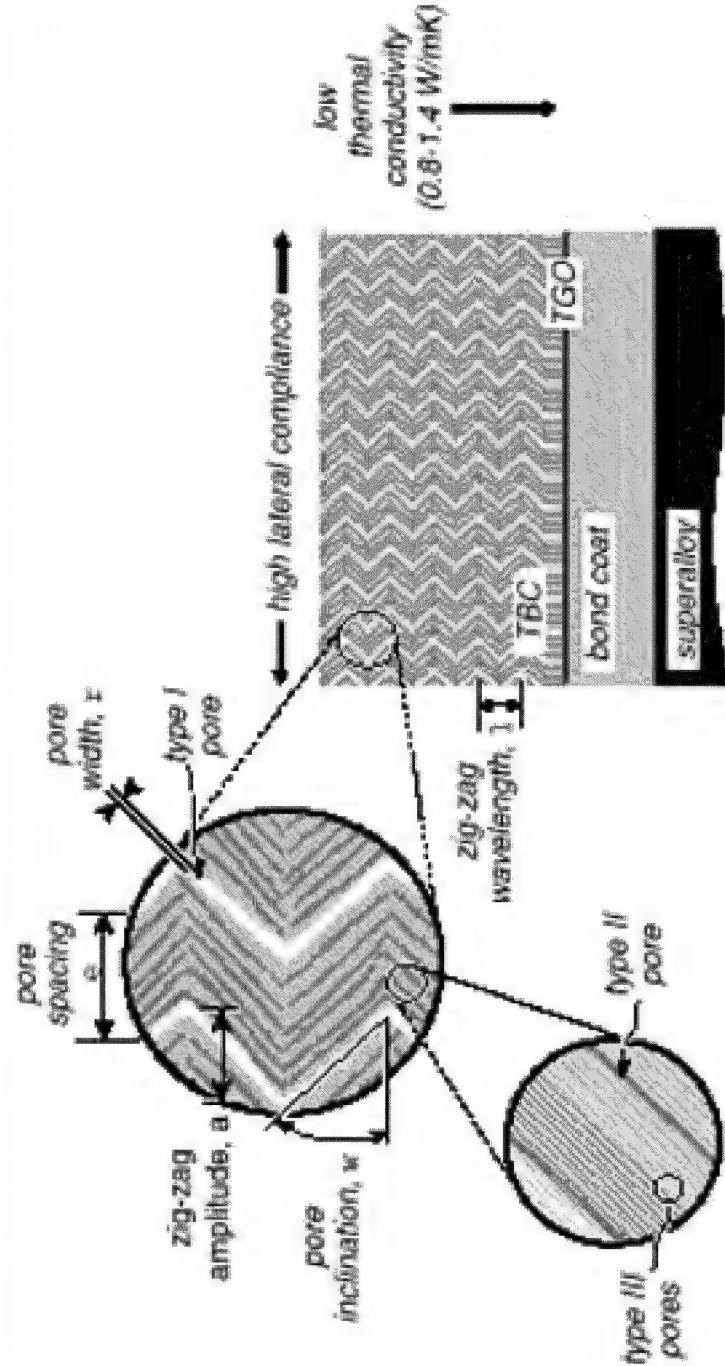


# IR Microscopy of Coatings EB-DVD method

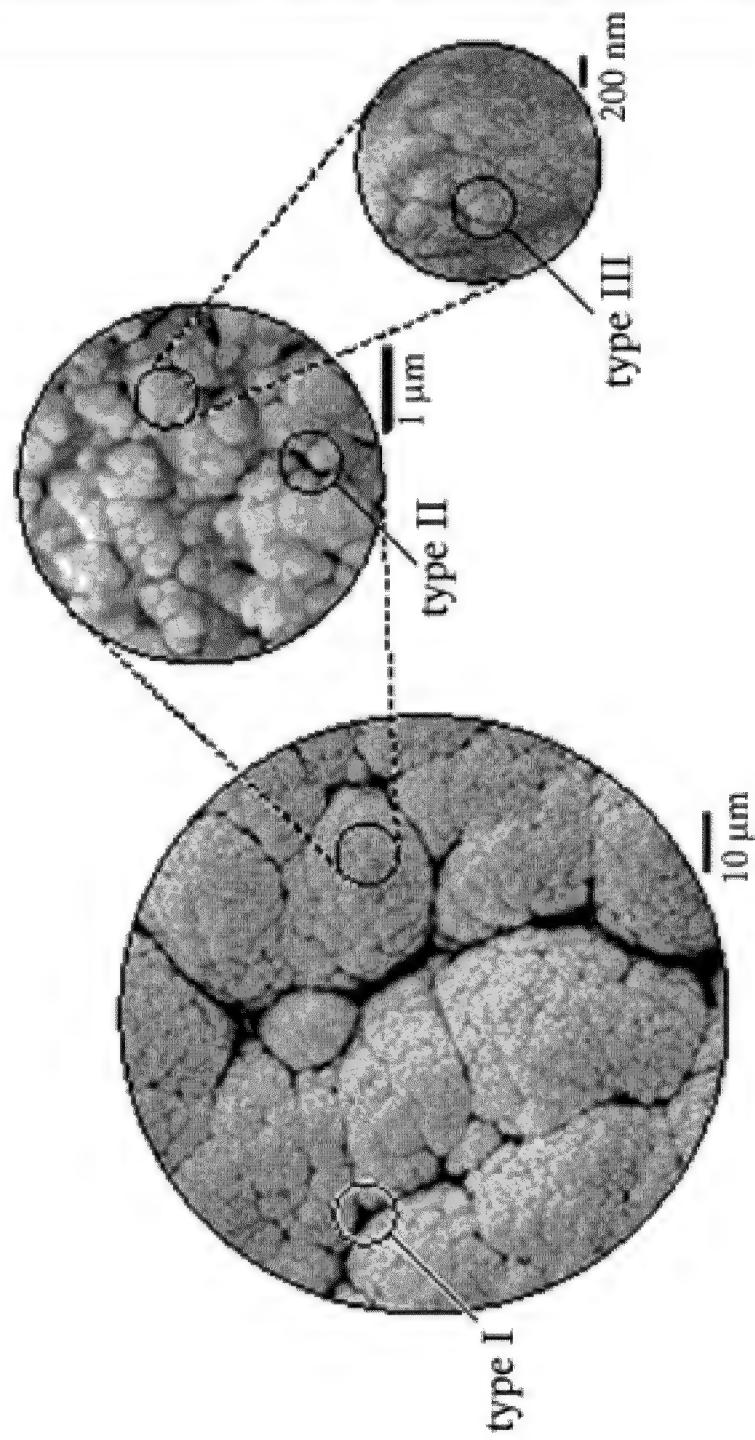
*EB-DVD Processing Approach*



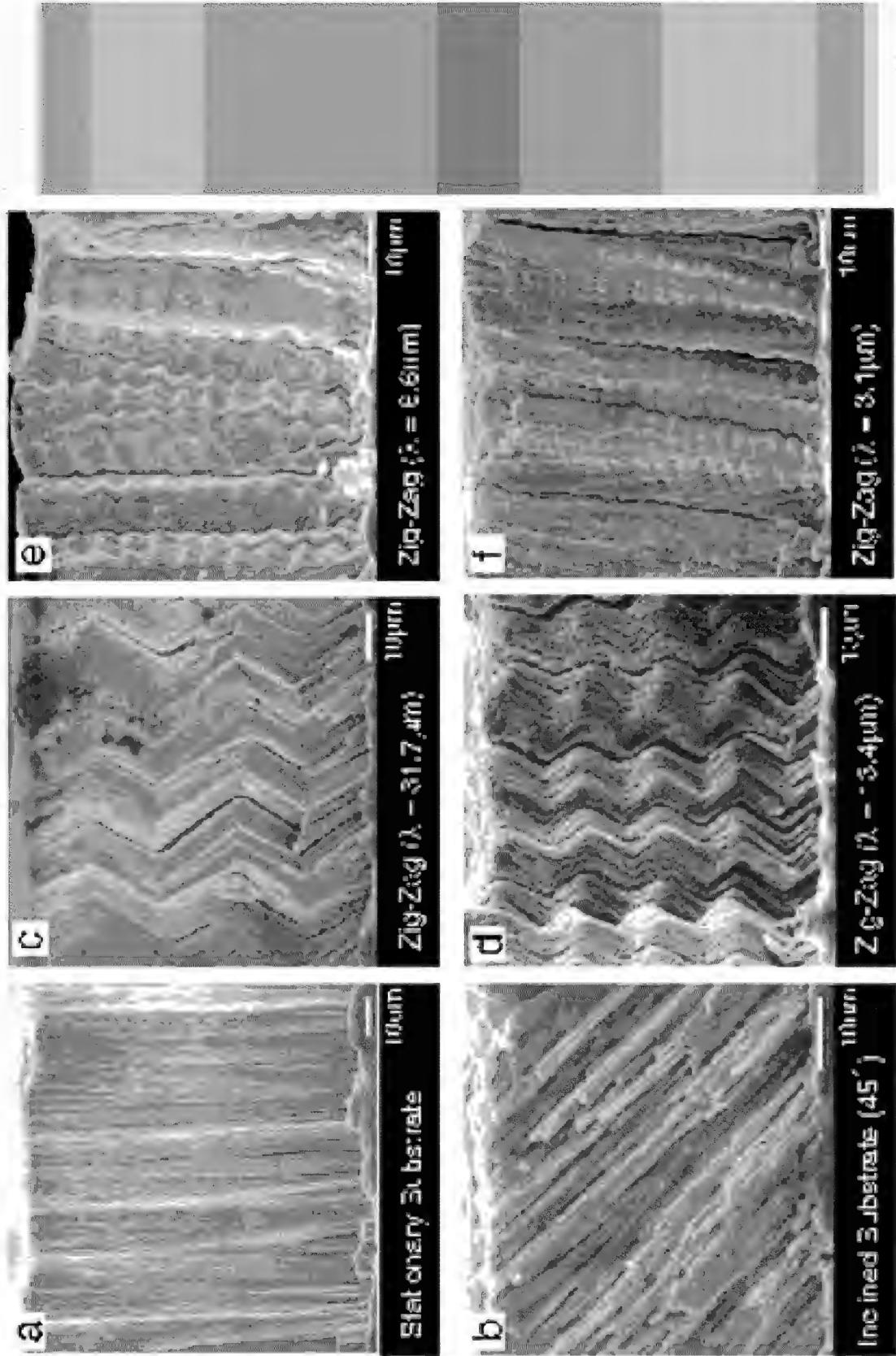
# Zig-Zag Coatings



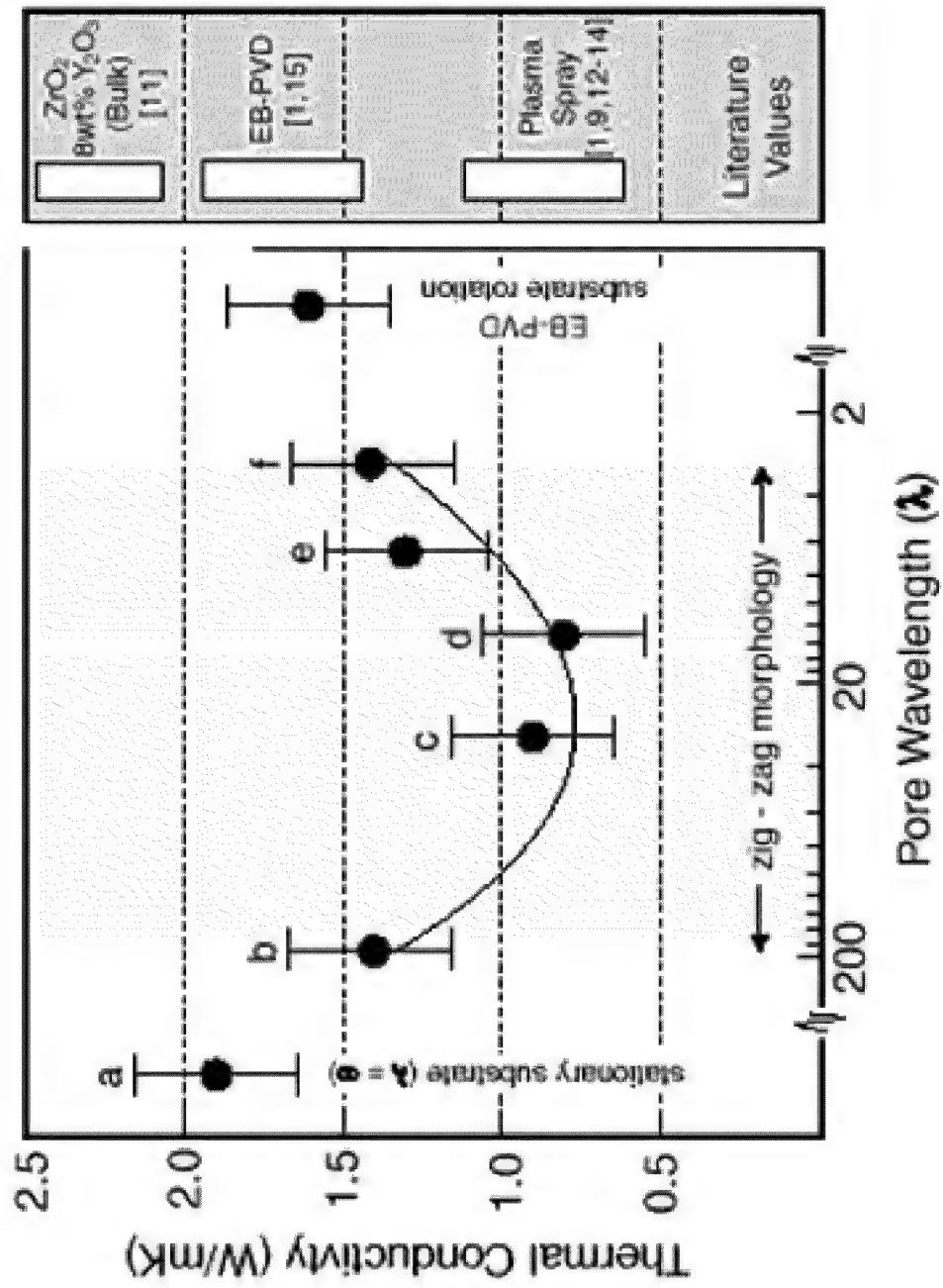
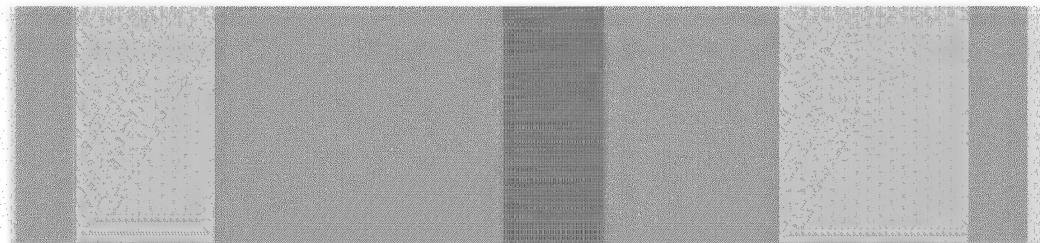
# Pore Morphology



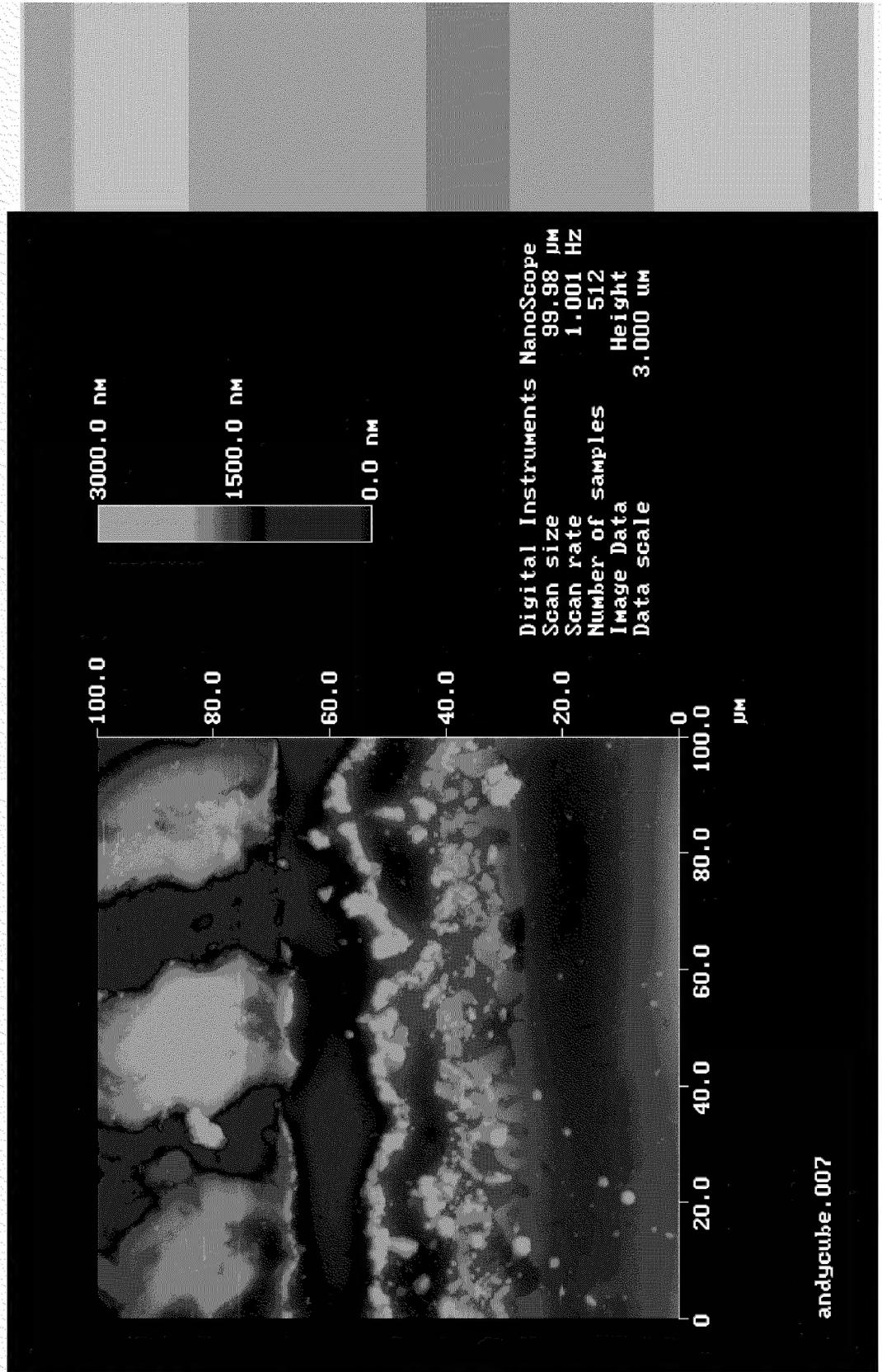
# EB-DVD Coating Morphologies



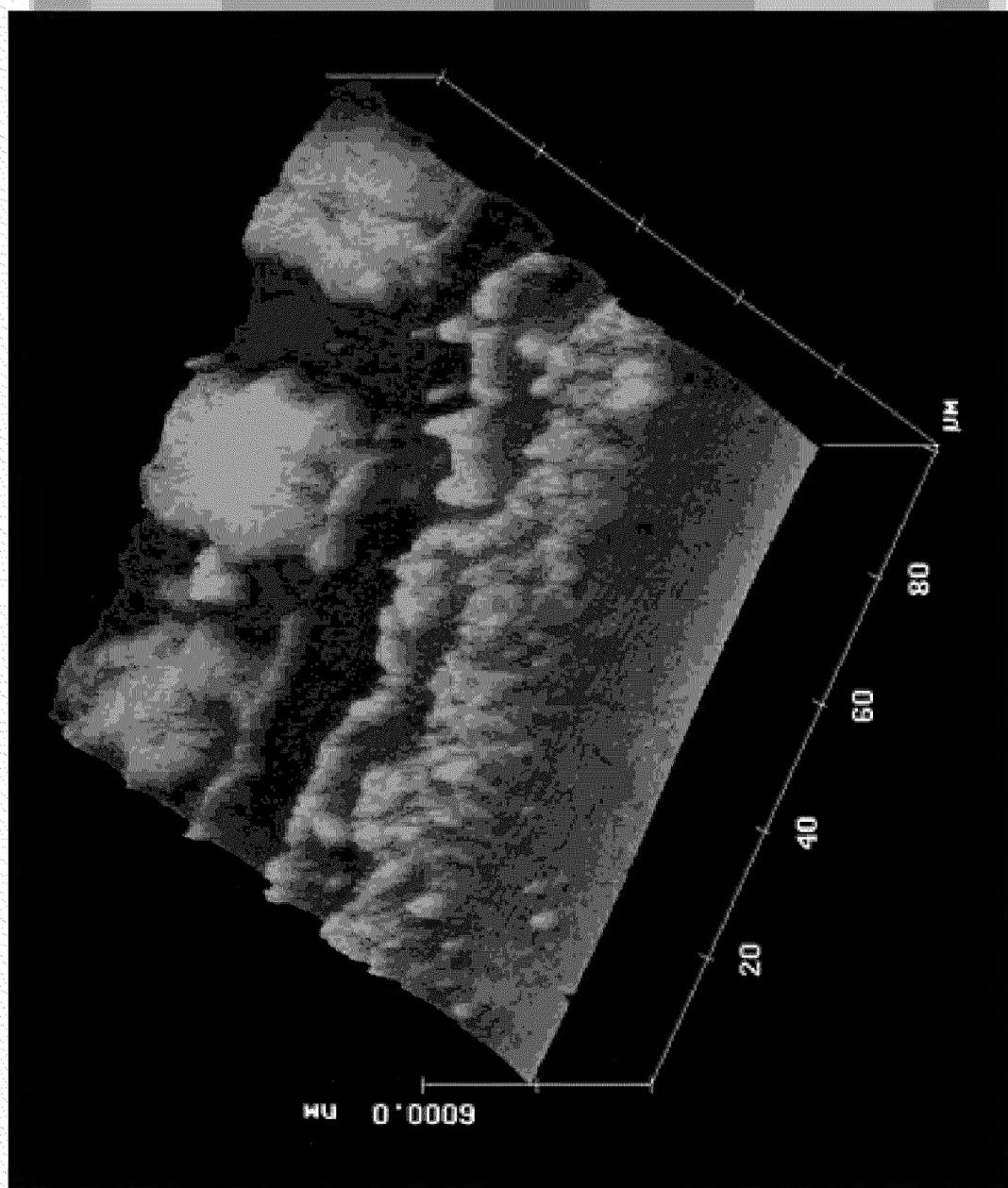
# Coating Thermal Conductivity



# Scanned-probe microscopy

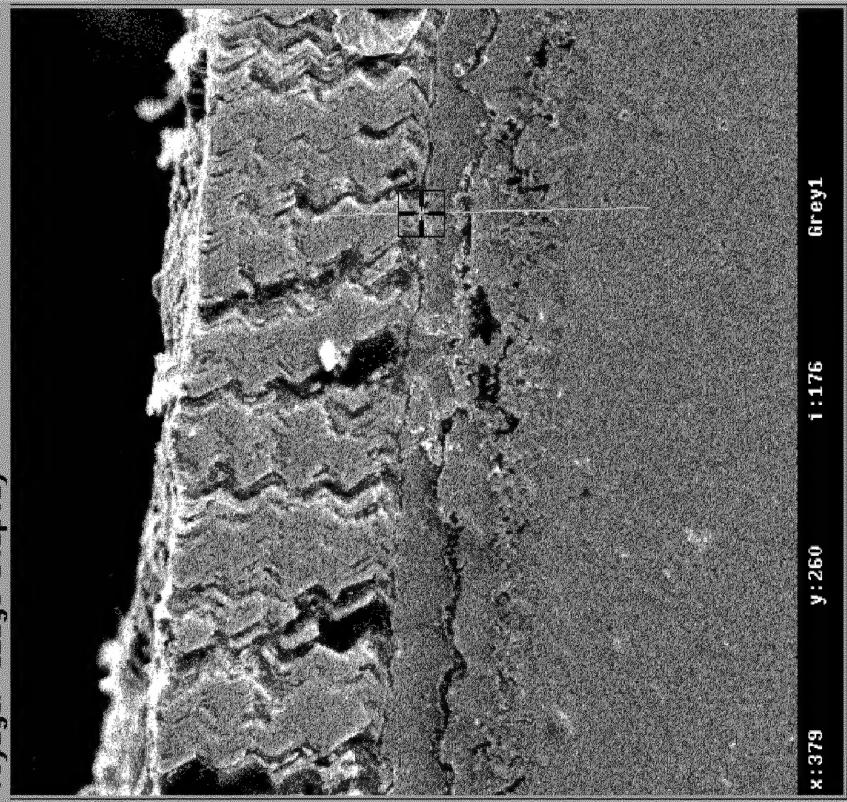


# Polishing is an Issue



# Analysis of the Layers

Voyager Image Display

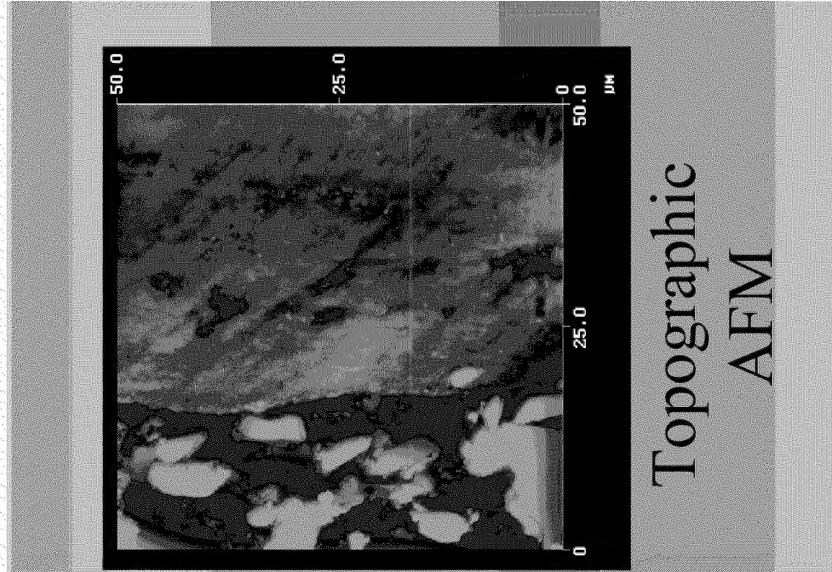
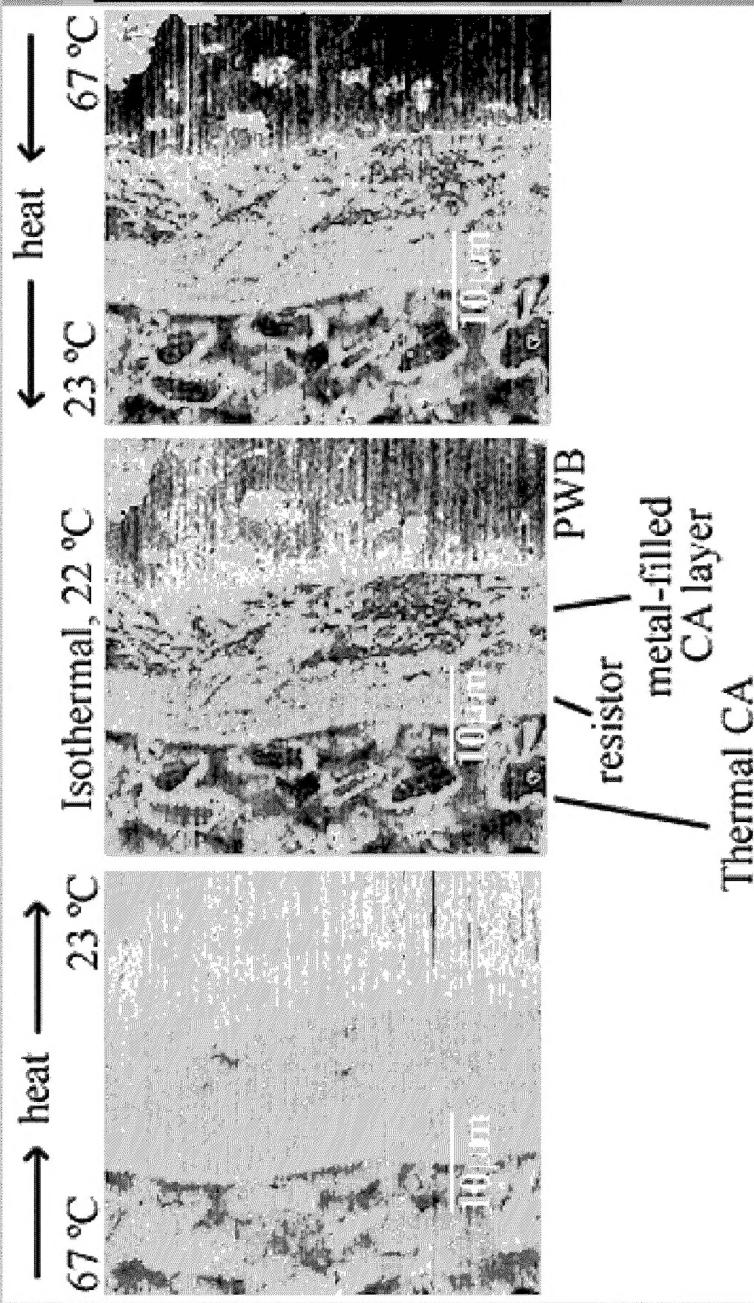


Linescan Display

VFS:	105	-
Al_K:	66	-
VFS:	313	-
Zr_L:	54	-
VFS:	518	-
Cr_K:	23	-
VFS:	156	-
Fe_K:	19	-
VFS:	368	-
Ni_K:	119	-
VFS:	17	-
Cu_K:	5	-
VFS:	12	-
Zn_K:	5	Pt. #: 32 Distance: 12.001 mm

x:379 y:260 i:176 grey1

# Thermal SPM



Topographic AFM